

DOCUMENT RESUME

ED 085 491

95

CE 000 608

AUTHOR Cunningham, J. W.
TITLE Development and Validation of the Occupational Analysis Inventory: An "Ergometric" Approach to an Educational Problem.
INSTITUTION National Center for Occupational Education, Raleigh, N. Car.
SPONS AGENCY National Center for Educational Research and Development (DHEW/OE), Washington, D.C. Div. of Research and Development Resources.
REPORT NO OP-15
BUREAU NO BR-7-0348
PUB DATE 72
GRANT OEG-2-7-070348-2698
NOTE 19p.; Paper presented at Annual Convention of the American Psychological Association (80th, Honolulu, Sept. 1972); For full report, see CE 000 612
EDRS PRICE MF-\$0.65 HC-\$3.29
DESCRIPTORS Aptitude Tests; Behavior; Cluster Analysis; Correlation; Factor Analysis; Human Engineering; *Job Analysis; *Occupational Clusters; *Occupational Information; Occupations; *Psychological Tests; *Psychometrics; Statistical Analysis; Work Environment
IDENTIFIERS *Ergometrics; Occupation Analysis Inventory

ABSTRACT

Ergometrics, the application of psychometric principles and procedures to the study of human work, draws from theories and principles of human behavior as well as from established procedures in psychological measurement and job analysis. The project described employs ergometrics to describe, compare, and group occupations for educational purposes. An Occupation Analysis Inventory (OAI) was generated containing 622 work elements (descriptions of activities and conditions). Ratings on the work elements were obtained by relevance to 103 defined human attributes (resulting in attribute-requirement weights). The OAI work elements were then correlated and subjected to factor analysis. Five test batteries and inventories measuring various abilities, interests, needs and satisfaction were used to discover relationships between these variables and measurable behavioral potentials. Clusters of occupations were found to be discriminable and significant cross-validated multiple correlations between OAI factor scores and aptitude test scores were obtained. Other findings also indicate that a meaningful and potentially useful set of occupational descriptors has been developed and validated. (MS)

ED 085491



U.S. DEPARTMENT OF HEALTH
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY.

DEVELOPMENT AND VALIDATION OF THE
OCCUPATION ANALYSIS INVENTORY:
AN "ERGOMETRIC" APPROACH TO AN
EDUCATIONAL PROBLEM

J. W. CUNNINGHAM

DEPARTMENT OF PSYCHOLOGY
NORTH CAROLINA STATE UNIVERSITY AT RALEIGH

OCCASIONAL PAPER NO. 15

NATIONAL CENTER FOR OCCUPATIONAL EDUCATION
NORTH CAROLINA STATE UNIVERSITY AT RALEIGH

1972

U. S. DEPARTMENT OF HEALTH, EDUCATION, WELFARE
OFFICE OF EDUCATION
NATIONAL CENTER FOR EDUCATIONAL RESEARCH AND DEVELOPMENT
DIVISION OF RESEARCH AND DEVELOPMENT RESOURCES
PROJECT NO. BR-7-0348, GRANT NO. OEG-2-7-070348-2698
TRANSACTION NO. 71-O-E3002

FILMED FROM BEST AVAILABLE COPY

CE 000 608

NATIONAL CENTER FOR OCCUPATIONAL EDUCATION

RESEARCH-DEVELOPMENT-TRAINING

The National Center for Occupational Education was established as a research and development center in 1965, originally under the provisions of Section 4(c) of the Vocational Education Act of 1963. Using a broad definition of occupational education as the process of preparing youth for adult work roles, and the continued preparation of adults for new roles, the Center has concentrated on fundamental problems in occupational education since its inception.

The Center has been established as an integral unit within the School of Education at North Carolina State University, with cooperative efforts with the Schools of Agriculture and Life Sciences, Liberal Arts, and Physical and Mathematical Sciences. The Center, in part, participates in the program conducted by the Program Management Branch of the Division of Research and Development Resources, National Center for Education Research and Development, U. S. Office of Education. The National Center for Occupational Education as established at North Carolina State University, however, has been divided into four divisions, including the Division of Research and Development, the Division of Program Evaluation, the Division of Occupational Education Professional Personnel Development and the Division of Special Service Projects. The latter three divisions are supported chiefly from funds other than the primary grant from the U. S. Office of Education.

THE OCCASIONAL PAPER SERIES

The Occasional Paper Series has been established as a vehicle for the publication of short monographs of general interest to people involved in all areas of occupational education. For the most part, these monographs consist of papers or speeches written or delivered by members of the Center staff as a consequence of their affiliation with the Center. It is the express purpose of this series to ensure that such efforts on the part of those connected with the Center will be made available to a general readership and not restricted solely to the audience for whom they were initially prepared.

Consistent with its policies in other Center series, the National Center for Occupational Education will not undertake the publication of monographs in this series unless they meet the highest standards of professional quality. It is the responsibility of the Director of the Center to ascertain whether or not the report is appropriate for inclusion in the Occasional Paper Series.

ADDITIONAL INFORMATION

For additional information regarding the program of the Center, please write to:

Dr. John K. Coster, Director
National Center for Occupational Education
North Carolina State University at Raleigh
Raleigh, North Carolina 27607

ED 085491

DEVELOPMENT AND VALIDATION OF THE OCCUPATION ANALYSIS INVENTORY:
AN "ERGOMETRIC" APPROACH TO AN EDUCATIONAL PROBLEM

J. W. Cunningham

Department of Psychology

The presentation reported herein was made pursuant to a grant from the Office of Education, U. S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

Occasional Paper No. 15

CENTER FOR OCCUPATIONAL EDUCATION
North Carolina State University at Raleigh

1972

Project No. 7-0348
Grant No. OEG-2-7-0348-2698

PREFACE

This paper was originally prepared for the symposium "Directions in Work Analysis," L. R. Taylor, chairman, presented at the 80th Annual Convention of the American Psychological Association held in Honolulu, Hawaii, in September, 1972.

The Center wishes to thank Dr. Cunningham for making this presentation available for publication. It is a concise description of the Center's work in the area of ergometrics.

The author and the Center also express appreciation to Mrs. Sue King for editing the draft of this paper, to Mrs. Joyce Pollard for typing the manuscript, and to the entire Center technical and clerical staff for their contributions to the publications of this paper.

John K. Coster
Director

TABLE OF CONTENTS

	<u>Page</u>
PREFACE	ii
Background and Purpose.	1
Instrument Development.	2
Procedures and Results.	3
Conclusion.	12

Background and Purpose

The project I shall describe is supported by the Center for Occupational Education at North Carolina State University and is directed toward the problem of establishing structure and content in occupationally related education. There has existed for some time in this field the need for a systematic basis for gathering and organizing information from the work domain that can be used for such educational purposes as curriculum development and evaluation, occupational guidance and placement, and occupationally related test development.

Some of us at the Center felt that the existing technology in work analysis could be brought to bear upon this problem. Of particular interest to us was the potential application of the psychometric approach to work analysis, which can be traced as far back as Viteles' job psychograph and which has seen its most recent development in such efforts as E. J. McCormick's worker-oriented approach, the task-inventory approach of the U. S. Air Force, and the worker-function approach of the U. S. Training and Employment Service. The term we have coined to apply to the psychometric approach to work analysis is "ergometrics."¹ The field of ergometrics, as we conceive it, draws from theories and principles of human behavior, as well as from established procedures in psychological measurement and job analysis.

¹The application of psychometric principles and procedures to the study of human work.

The purpose of the project I am reporting is to apply the procedures and concepts of ergometrics--particularly those of McCormick and his associates--in the development of a system for describing, comparing, and grouping occupations for educational purposes.

Instrument Development

The first phase of our project involved the development of the Occupation Analysis Inventory, which contains 622 work elements (or descriptions of work activities and conditions) on which jobs and occupations are rated. Although the Occupation Analysis Inventory (or OAI) employs several rating scales, a six-point significance-to-the-job scale is most frequently used. The OAI work elements were generated within the broad framework of an information processing paradigm. The five labeled components of this paradigm defined the major categories of the OAI, and these major categories were subdivided according to selected conceptual frameworks pertaining to human behavior and work technology. The work elements were constructed within the subcategories.

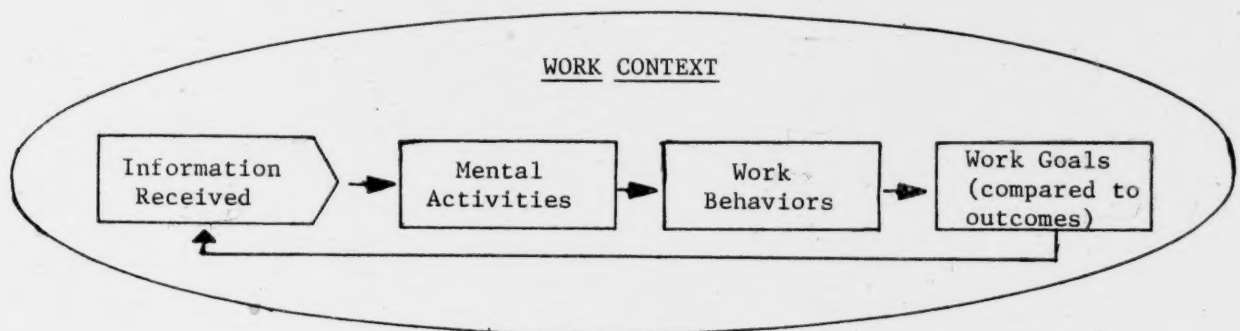


Figure 1. Paradigm for the Occupation Analysis Inventory (OAI)

Procedures and Results

The basic data in our project were obtained from two independent sets of ratings on the work elements in the Occupation Analysis Inventory.

The first set of data consisted of ratings of the relevance of 103 defined human attributes to each of the 622 OAI work elements. The human attributes fell into the six categories shown in Figure 2. Ten advanced graduate students rated each OAI work element on its requirement for each of the 103 attributes; these ratings were then averaged across the judges, yielding a profile of mean attribute-requirement weights for each work element. The resulting attribute-requirement weights are presented by the entries in Matrix A (see Figure 3).

CATEGORIES OF HUMAN ATTRIBUTES

GENERAL VOCATIONAL CAPABILITIES

COGNITIVE ABILITIES

PSYCHOMOTOR ABILITIES

SENSORY CAPACITIES

INTERESTS

NEEDS

Figure 2.

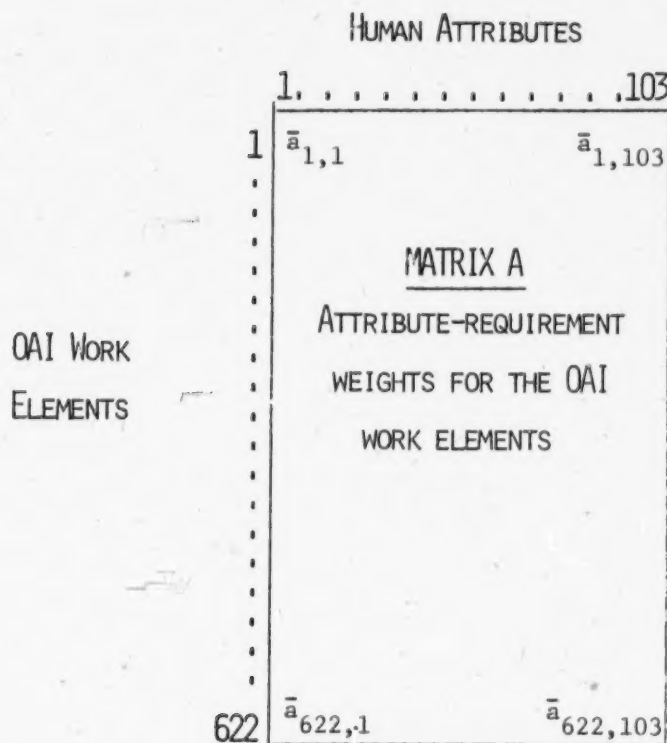


Figure 3.

A second set of data consisted of the ratings of 800 occupations on the OAI by professional job analysts and experienced graduate students. These are depicted by Matrix B, where each entry represents the rating of an occupation on an OAI work element (see Figure 4). The ratings were based on written job analysis schedules obtained from the U. S. Training and Employment Service.

The next step in our project involved the derivation of attribute-requirement estimates for occupations, following McCormick's "synthetic" (or job component) procedure. Essentially, this step consisted of the multiplication of the two data matrices just described (see Figure 5). Matrix A in Figure 5 represents the attribute-requirement weights for the 622 OAI work elements, and Matrix B represents the OAI ratings of

800 occupations. Each entry in Matrix C, the product matrix, represents an attribute-requirement estimate for an occupation. These attribute-requirement estimates were standardized and were found to have adequate inter-rater reliabilities. The median reliability, based on two OAI ratings of a sample of 215 occupations, was .88.

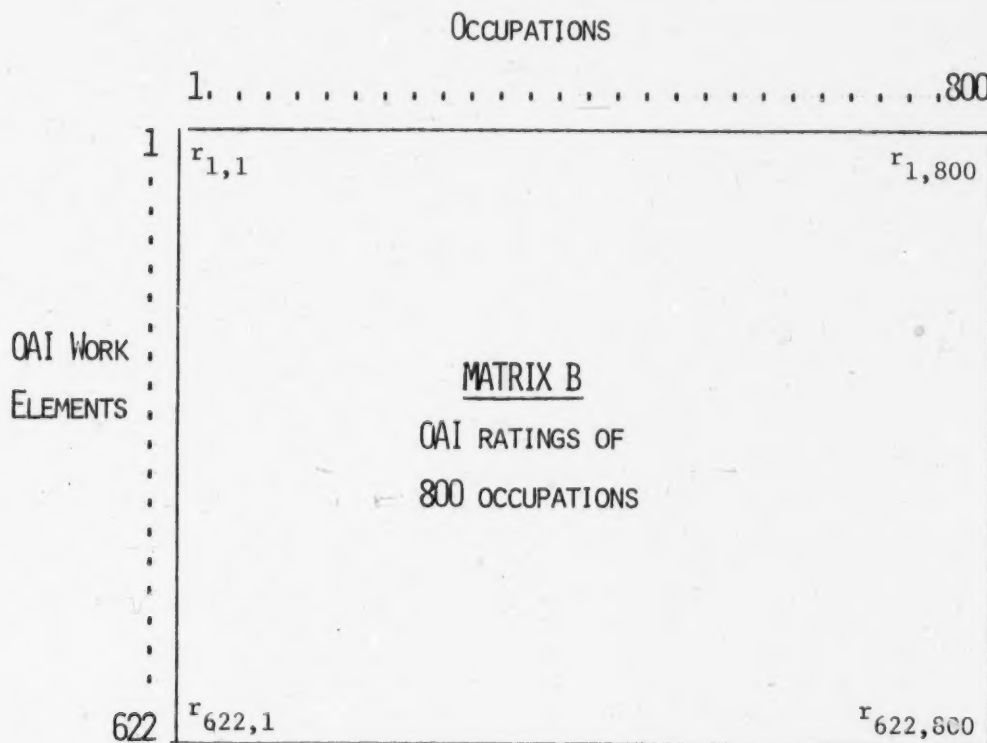


Figure 4.

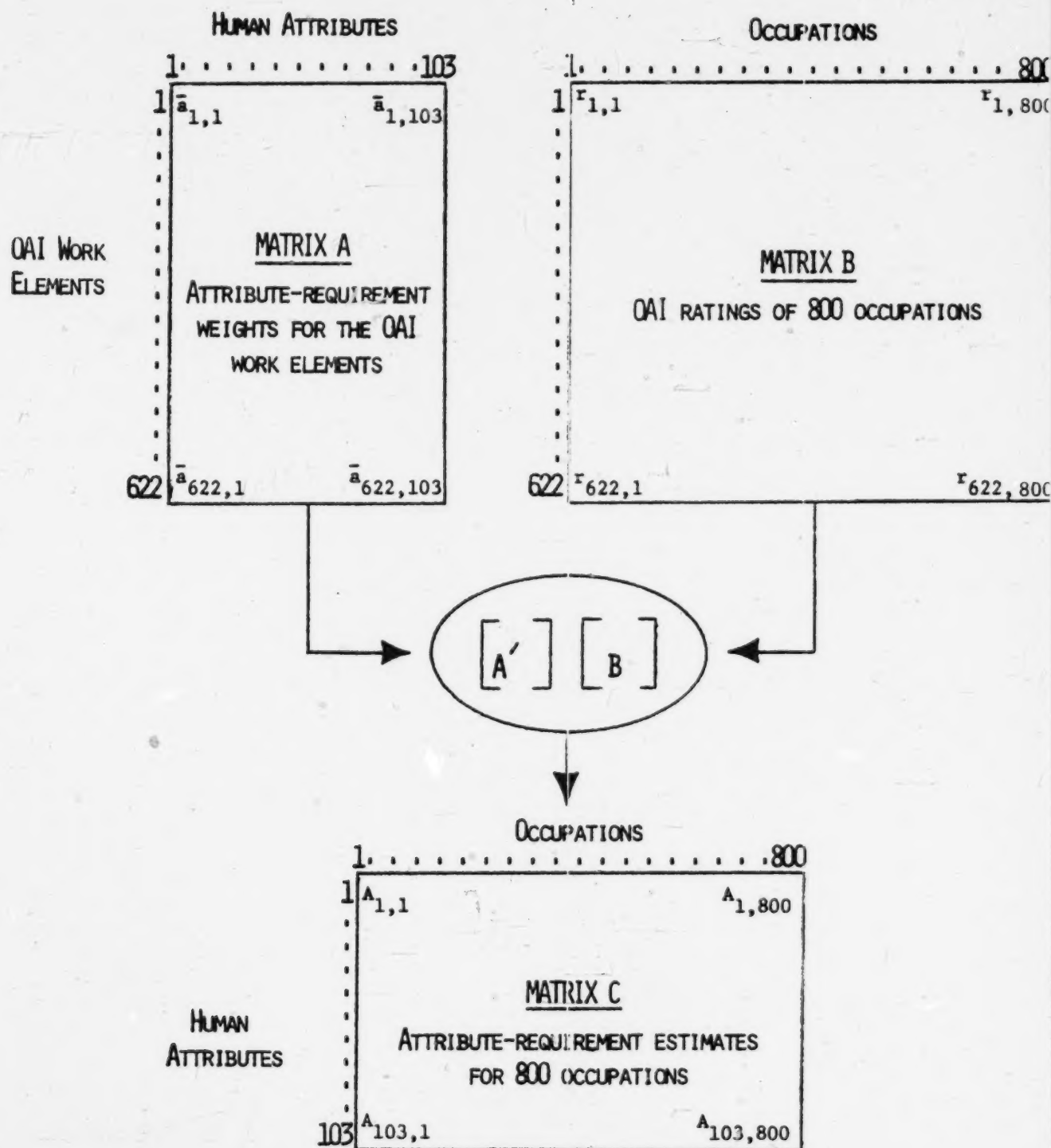


Figure 5.

The two basic data matrices were also subjected to factor analysis. In the case of Matrix B, the OAI work elements were intercorrelated based on the occupation ratings, and the resulting correlations were used in factor analyzing seven separate sections of the OAI (see Figure 6). These seven analyses produced 90 first-order factors which, in turn, were subjected to a factor analysis yielding 22 higher-order factors. The second data base for factor analysis consisted of the attribute-requirement weights for the OAI elements, represented by Matrix A (see Figure 7). In this instance, the work elements were intercorrelated based on their attribute-requirement profiles, and, with the exception of one omitted section of the OAI, the previous factor analyses were repeated. These analyses produced 77 first-order and 21 higher-order factors. For the most part, our factors were meaningful, had adequate inter-rater reliabilities, and showed reasonable stability based on Tucker's coefficient of congruence. For the first-order occupation-rating factors, the median reliability, based on two OAI ratings of a sample of 215 occupations, was .82. The median coefficient of congruence for the first-order occupation-rating factors was .72, and for the first-order attribute-rating factors, .86.

Based on our results, we were able to describe occupations in two ways: (1) in terms of their estimated requirements for defined human attributes for which there are tests and (2) in terms of their scores on factors representing different types of work activities and conditions. In addition, we could say that whatever we were measuring with these variables could be measured with reasonable precision.

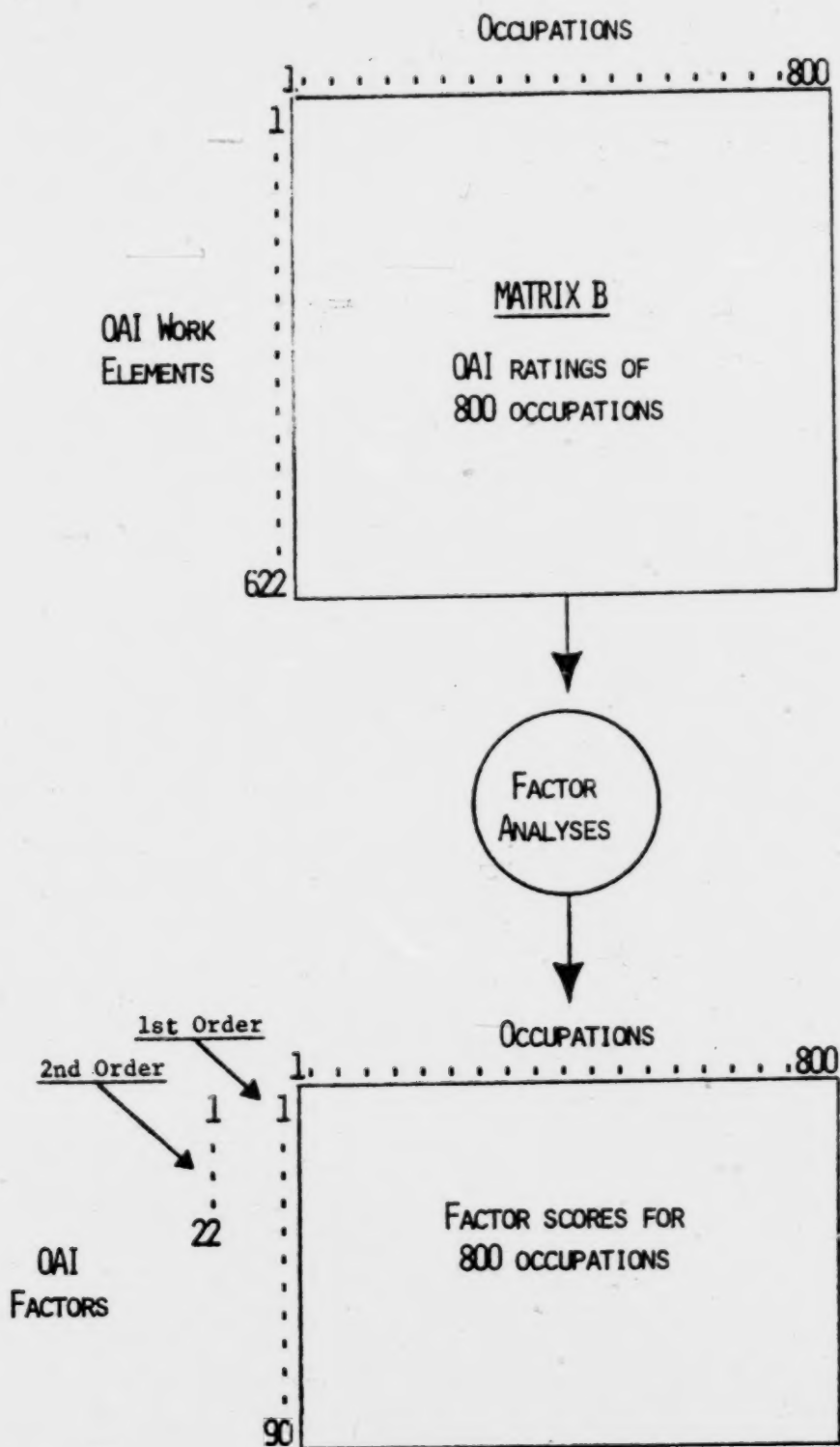


Figure 6.

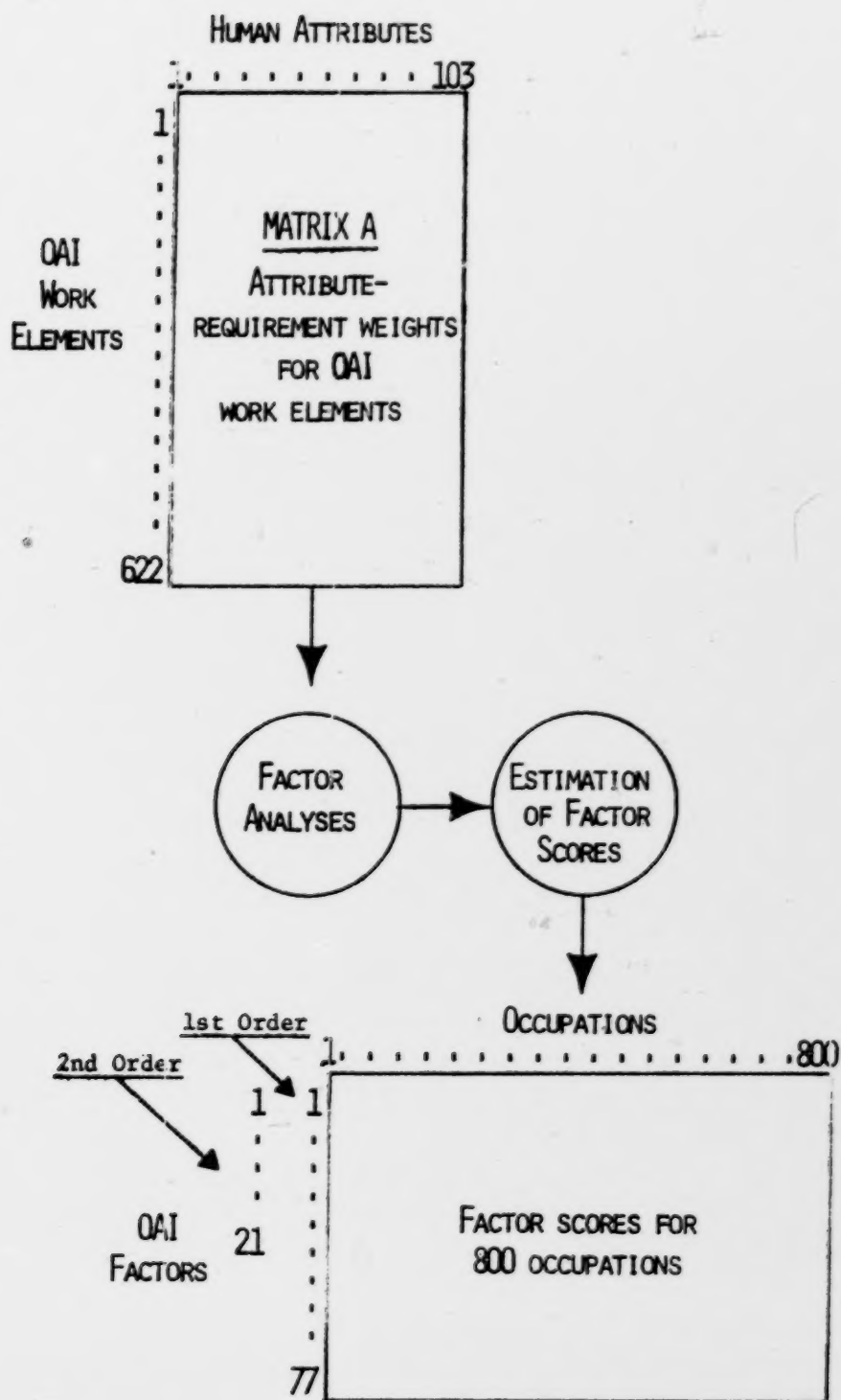


Figure 7.

Having accomplished this, we proceeded with an attempt to establish some degree of construct validity for our two sets of occupational descriptors. Our rationale was that if the OAI attribute requirements and factors are actually relevant to human behavior, then it should be possible to demonstrate significant relationships between these variables and the behavioral potentials measured by selected tests. For this purpose, we chose five test batteries and inventories measuring various abilities, interests, needs, and satisfactions (see Figure 8). Test data were either collected or located on incumbents or graduate trainees in different occupations, and these occupations were rated on the OAI. In our validation analyses, the OAI factor scores and attribute-requirement estimates for occupations served as the independent (or predictor) variables, and the test and inventory scores of persons in the occupations served as the dependent variables.

TESTS AND INVENTORIES

GENERAL VOCATIONAL CAPABILITY TESTS

GENERAL APTITUDE TEST BATTERY

OHIO VOCATIONAL INTEREST SURVEY

MINNESOTA IMPORTANCE QUESTIONNAIRE (NEEDS)

MINNESOTA SATISFACTION QUESTIONNAIRE

Figure 8. Tests and inventories used in validating the OAI

Here is a brief summary of our results (see Table 1). Using the OAI factors as independent variables, we found that clusters of occupations with similar factor-score profiles were significantly discriminable (by analysis of variance) in terms of the various test and inventory

Table 1. Validation of the Occupational Descriptors

Independent Variables	Dependent Variables (test scores)	Analyses	Results*
<u>Occupational Clusters</u> (based on 1st-order occup. rating factors)	Gen. Voc. Capability Tests Gen. Apt. Test Battery Ohio Voc. Interest Survey Minn. Impt. Questionnaire	ANOVA ANOVA ANOVA ANOVA	8 of 8 sig. 7 of 8 sig. 22 of 24 sig. 15 of 20 sig.
<u>OAI Factors</u> (2nd-order occup. rating factors)	Gen. Apt. Test Battery	Mult R	16 of 16 sig.; median cross- validated R=.59
<u>Attribute-Requirement</u> <u>Estimates</u>			
<u>Aptitudes</u>	Gen. Apt. Test Battery	$\bar{r}$	10 of 12 sig.; median $\bar{r}=.62$
<u>Interests</u>	Ohio Voc. Interest Survey	$\bar{r}$	16 of 24 sig.; median $\bar{r}=.39$
<u>Gen. Voc. Capabilities</u>	Gen. Voc. Capability Tests	ANOVA	7 of 8 sig.
<u>Needs</u>	Minn. Satis. Questionnaire	ANOVA	10 of 15 sig.

*p < .05

scores of persons in these occupations. For example, of the 60 analyses involving clusters based on first-order occupation-rating factors, 52 significant F values were obtained. In addition, we obtained significant cross-validated multiple correlations between the OAI factor scores for a sample of occupations and the average aptitude test scores of incumbents in these occupations! The median cross-validated multiple R for the second-order occupation-rating factors was .59.

In validating the OAI attribute-requirement estimates, we found significant correlations between the estimated requirements of occupations for various aptitudes and interests and the average scores of job incumbents on corresponding tests and inventory scales. The median correlation for aptitudes was .62 and, for interests, .39. We also established significant relationships (by analysis of variance) between the estimated requirements of occupations for eight general vocational capabilities and the general vocational capability test scores of persons trained for the occupations. In this instance, seven of the eight analyses yielded significant F values. Finally, we were able to demonstrate (again, by analysis of variance) some relationships between the OAI estimates for occupations on 15 different need dimensions and the scores of incumbents on corresponding satisfaction scales. Significant F values were obtained for 10 of the 15 need dimensions tested.

Conclusion

In conclusion, we feel that we have developed a meaningful and potentially useful set of occupational descriptors, and that we have provided some evidence for their validity.

Our immediate plans call for repeating the factor analyses of the OAI based on a cumulative sample of 1400 occupations. We will then use these factors as a basis for clustering the occupations.

It is our hope that the resulting factor and occupational cluster structures will prove useful in the areas of curriculum analysis and development, occupational guidance, and test development. For example, it might prove feasible to develop curricula corresponding to various occupational clusters. In this case, the curricular content would be derived from descriptions of tasks and conditions that occur in selected occupations in each cluster and that are relevant to the important dimensions in the cluster's work-factor profile. In the occupational guidance setting, the test-score profiles of individuals could be compared with the attribute-requirement estimates of various occupational clusters, and indices of profile congruence could be computed. Moreover, the factor-score profiles and task descriptions for the occupational clusters might be translated into information that the counselee could use in occupational exploration and decision-making. Finally, it would seem feasible to develop tests and inventories based on the systematically derived work factors and occupational clusters. Examples might include interest scales and general occupational capability tests based on the work factors (or dimensions), and occupational awareness (information) and proficiency tests based on the occupational clusters.

We are encouraged by our findings to date and are formulating long-range development plans in some of the areas just mentioned.

ERGOMETRIC RESEARCH AND DEVELOPMENT REPORTS
Center for Occupational Education
North Carolina State University, Raleigh

- Report No. 1 Cunningham, J. W., Editor. The Job-Cluster Concept and Its Curricular Implications: A Symposium. Center Monograph No. 4, 1969.
- Report No. 2 Cunningham, J. W. "Ergometrics": A Systematic Approach to Some Educational Problems. Center Monograph No. 7, 1971.
- Report No. 3 Cunningham, J. W., T. C. Tuttle, J. R. Floyd, and J. A. Bates. The Development of the Occupation Analysis Inventory: An "Ergometric" Approach to an Educational Problem. Center Research Monograph No. 6, 1971.
- Report No. 4 Neeb, R. W., J. W. Cunningham, and J. J. Pass. Human Attribute Requirements of Work Elements: Further Development of the Occupation Analysis Inventory. Center Research Monograph No. 7, 1971.
- Report No. 5 Riccobono, J. A., and J. W. Cunningham. Work Dimensions Derived Through Systematic Job Analysis: A Study of the Occupation Analysis Inventory. Center Research Monograph No. 8, 1971.
- Report No. 6 Riccobono, J. A., and J. W. Cunningham. Work Dimensions Derived Through Systematic Job Analysis: A Replicated Study of the Occupation Analysis Inventory. Center Research Monograph No. 9, 1971.
- Report No. 7 Tuttle, T. C., and J. W. Cunningham. Affective Correlates of Systematically Derived Work Dimensions: Validation of the Occupation Analysis Inventory. Center Research Monograph No. 10, 1972.
- Report No. 8 Bates, J. A., and J. W. Cunningham. Cognitive Correlates of Systematically Derived Work Dimensions: Validation of the Occupation Analysis Inventory. Center Research Monograph No. 11, in press.